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Evaluation of Modeling Approaches to Simulate Contaminant Transport in a Fractured Limestone Aquifer

Monday, September 28, 2015: 2:00 p.m.

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Understanding the fate and transport of contaminants in limestone aquifers is important because they are a major drinking water resource. This is challenging because they are often heavily fractured and contain chert layers and nodules. Several modeling approaches have been developed to describe contaminant transport in fractured media, such as discrete fracture, equivalent porous media, and dual continuum models. However, these modeling concepts are not well tested for real limestone geologies. Our goal is therefore to develop, evaluate, and compare approaches for modeling transport of contaminants in fractured limestone aquifers.

The model comparison is conducted for a contaminated site in Denmark, where a plume of dissolved PCE has migrated through a fractured limestone aquifer. Field data includes information on spill history, distribution of the contaminant (multilevel sampling), geology, and hydrogeology. To describe the geology and fracture system, data from borehole logs and cores was combined with an analysis of heterogeneities and fractures from a nearby excavation and pump test data. We present how field data is integrated into the different model concepts. A challenge in the use of field data is the determination of relevant hydraulic properties and interpretation of aqueous and solid phase contaminant concentration sampling data. Traditional water sampling has a bias towards fracture sampling; however, concentrations in the limestone matrix are needed for assessing contaminant rebound and remediation strategies.

Each model is compared with field data, considering both model fit and model suitability. Results show a considerable difference between the approaches, and that it is important to select the right one for the actual modeling purpose. The comparison with data showed how much information is required to discriminate between models, and recommendations on how to identify the best modeling approach are made.